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Short Report

Incidence of the coracoclavicular joint in South African populations

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ABSTRACT

The presence of a diarthrotic coracoclavicular joint, as represented by an articular facet on the conoid tubercle of the clavicle and the superior surface of the coracoid process of the scapula, was investigated. The sample consisted of 60 white and 180 black South African (60 Sotho, 60 Xhosa and 60 Zulu) skeletons. Each group consisted of 30 male and 30 female skeletons. The presence of the articular facet was recorded as either bilateral, unilateral left or unilateral right. The effect of clavicular length, scapular size and first rib angle on the presence of the coracoclavicular joint was also investigated. The presence of the articular facet was noted in 23 (9.6%) of the 240 individuals studied. Of these 23 individuals, 6 (26.1%) were white and 17 (73.9%) were black. Males (56.5%) presented a higher incidence of this anomaly than females (43.5%). The articular facet occurred bilaterally in 47.9% (11/23), unilaterally on the left in 30.4% (7/23) and unilaterally on the right in 21.7% (5/23). Sexual, racial and tribal differences were not statistically significant. Individuals possessing the joint showed statistically significantly ($P < 0.01$) larger scapulae (increased border lengths and superior angles), longer clavicles and longer first ribs. No statistically significant differences in the first rib angles were observed between individuals who possessed the joint and those who did not, thus implying similar thoracic inlet size. It is proposed that the aforementioned morphometry of the scapulae, clavicles and first ribs may restrict associated movements of the scapulae, resulting in the development of the coracoclavicular joint.

Key words: Coracoclavicular joint; clavicle; scapula; population variation.

INTRODUCTION

The presence of an anomalous joint between the superior surface of the horizontal part of the coracoid process of the scapula inferiorly and the inferior surface of the conoid tubercle of the clavicle superiorly has occasionally been detected (Kaur & Jit, 1991). Nutter (1941) stated that an articular facet on the conoid tubercle will indicate the existence of a coracoclavicular joint. According to Lewis (1959), an articular facet in the region of the conoid tubercle of the clavicle has been recognised as an uncommon osteological feature. Abe (1964) and Cockshott (1979) stated that the joint is more common in Asians than in Europeans or Africans. To date there appear to have been no reports on the incidence of the coracoclavicular joint in South African populations.

The aim of the present study was to report on the incidence of this joint in adult South African population groups, to test the existence of any racial, sexual and tribal differences among them and to report on the differences, if any, on the morphometry of the clavicles, scapulae and first ribs due to the presence of the joint.

MATERIALS AND METHODS

Skeletons of 60 white and 180 black South African individuals from the Raymond A. Dart Collection housed in the Department of Anatomy and Human

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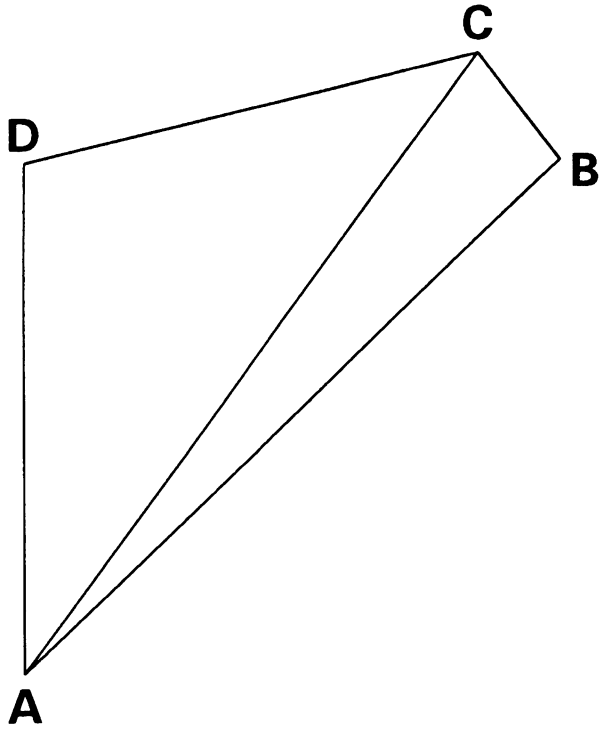

Fig. 1. Schematic diagram of the right scapula showing the different border lengths measured. AD, medial border length; DC, superior border length; CB, glenoid length; BA, lateral border length; AC, paracostal length.

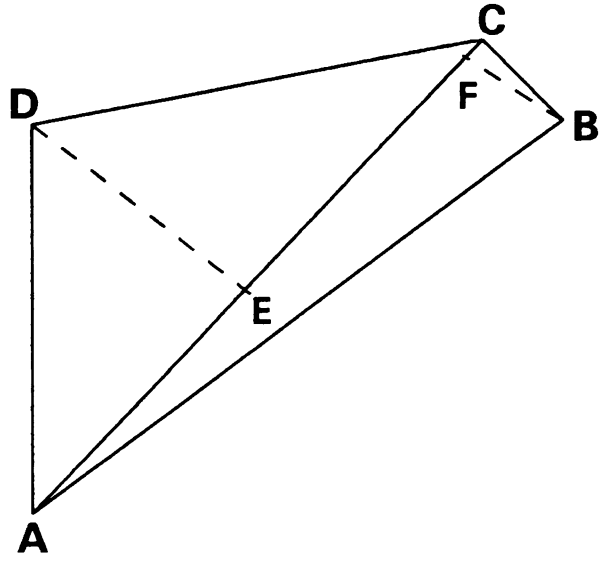

Fig. 2. Schematic diagram of the right scapula showing the different angles calculated. DE, vertex of triangle ACD; BF, vertex of triangle ABC. Using the Pythagoras theorem, $AE = (AD^2 - DC^2 + AC^2)/2*AC$ and $AF = (AB^2 - BC^2 + AC^2)/2*AC$. Therefore $EC = AC - AE$ and $FC = AC - AF$. Thus, inferior angle DAB = angle DAE + angle CAB = arccos (AE/AD) + arccos (AF/AB); superior angle CDA = angle ADE + angle CDE = {90 − arccos (AE/AD)} + arcsin (EC/DC); lateral superior angle DCB = angle DCE + angle BCF = {90 − arcsin (EC/DC)} + {90 − arcsin (FC/BC)}; and lateral inferior angle CBA = angle CBF + angle FBA = arcsin (FC/BC) + {90 − arccos (AF/AB)}.

Biology, University of the Witwatersrand, were used in the study. The black South African sample was equally divided into the 3 major tribal divisions, Sotho, Xhosa and Zulu. Each group consisted of 30 male and 30 female skeletons, ranging in age from 19 to 66 years. The sex and population grouping of each of the skeletons were taken from records in the collection.

In order to confirm the occurrence of the articular facet on the clavicle, the presence of a definite impression on the superomedial surface of the coracoid process of the scapula was sought. The presence of the articular facet was recorded as either bilateral, unilateral right or unilateral left.

The following measurements, using a vernier calliper (precision 0.02 mm), were taken on all individuals who exhibited the coracoclavicular joint and from 30 randomly selected individuals who did not possess the joint: (1) the length of the left and right clavicles; (2) the lengths of the medial, lateral and superior borders of the left and right scapulae; (3) the glenoid lengths; and (4) the distance between the head and the costochondral facet of the first rib. These measurements were used to calculate the following indices: (*a*) the inferior, medial and lateral angles of the left and right scapulae, and (*b*) the angles of the left and right first ribs.

Clavicular length was measured from the sternal facet medially to the acromial facet laterally. The lengths measured on the scapula (Fig. 1) were defined as follows: (1) medial border length (Fig. 1, AD) measured from the inferior angle to the superior angle of the scapula; (2) superior border length (Fig. 1, DC) measured from the superior angle of the scapula to the superior glenoid tubercle; (3) lateral border length (Fig. 1, AB) measured from the inferior angle of the scapula to the inferior glenoid tubercle; (4) the paracostal length (Fig. 1, AC) measured from the inferior angle of the scapula to the superior glenoid tubercle; and (5) the glenoid length (Fig. 1, CB) measured from the superior glenoid tubercle to the inferior glenoid tubercle.

The angles of the scapula were calculated by using the length of its borders and its glenoid articular surface (Fig. 2). The angle of the first rib was calculated firstly by measuring the distance between the head and the costochondral facet of the first rib and secondly the 'height' of the rib (Fig. 3).

The χ^2 test was used to determine whether any statistically significant racial, sexual or tribal differences existed. Student's t test was used to determine whether statistically significant differences occur between the different measurements taken from individuals showing the presence or absence of the joint.

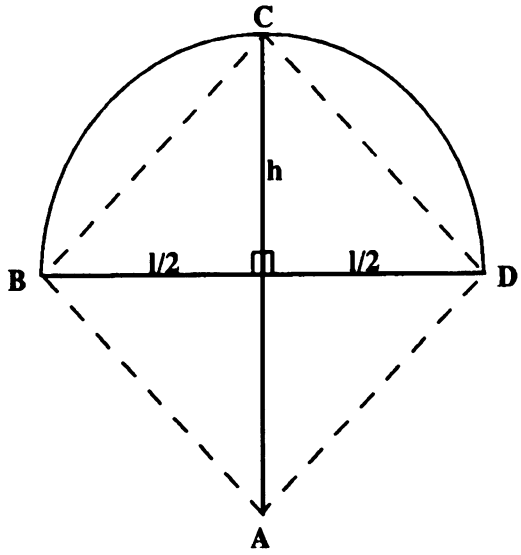

Fig. 3. Schematic diagram showing the calculation of the angles of the first rib. The rib can be regarded as an arc of a circle with radius AD or AB. If AC is the perpendicular bisector of line DB, then triangles ADC and ABC are isosceles triangles with angle BCA = angle ABC = angle ACD = angle ADC = arctan (1/2h). Thus angle DAC = angle BAC = {180−2[arctan (1/2h)]}. Therefore the angle of the rib = angle DAB = 2{180−2[arctan (1/2h)]}.

RESULTS

A coracoclavicular joint was noted in 23 (9.6%) of the 240 individuals examined in this study. The joint occurred bilaterally in 11 (47.9%), unilaterally on the left in 7 (30.4%) and unilaterally on the right in 5 (21.7%) of all individuals with the joint (Table 1). Of the 23 individuals who possessed the joint, 10% (6/60) were white and 9.4% (17/180) black. In the combined black and white samples, males (10.8%) showed a slightly higher frequency when compared with females (8.3%). This was also the case in the combined black South African sample with black males (58.8%) presenting a higher frequency than black females (42.2%). White males and females presented with equal frequencies. Of the black individuals, the Sotho tribe showed the highest incidence (41.2%), followed by the Xhosa tribe (35.3%) and lastly the Zulu tribe (23.5%). Racial, sexual, tribal and side differences were not found to be statistically significant ($P > 0.05$).

Fig. 4. Inferior surface of the lateral third of a right and left clavicle presenting with a unilateral left articular facet (F) of the coracoclavicular joint.

Table 1. *Incidence of the coracoclavicular articular facet in a black and white South African sample*

Group	Presence of facet		
	Bilateral	Unilateral left	Unilateral right
Sotho male	2	1	1
Sotho female	2	1	0
Xhosa male	2	2	0
Xhosa female	1	0	1
Zulu male	0	1	1
Zulu female	1	0	1
White male	2	0	1
White female	1	2	0
Total	11	7	5

n = 30 for each group.

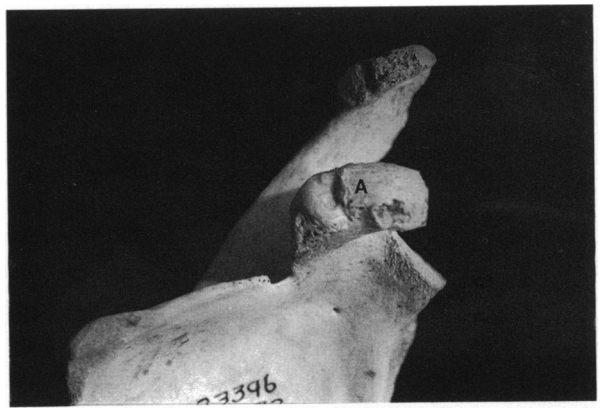

Fig. 5. Superior surface of the coracoid process of the left scapula showing the presence of an articular facet (A).

Individuals possessing a coracoclavicular joint showed statistically significantly longer first ribs, longer scapula border lengths (medial, lateral and superior), longer paracostal lengths and greater scapula superior angles ($P < 0.01$). No statistically significant differences were found for first rib height, clavicle and glenoid lengths or first rib angle. However, these measurements were larger in individuals possessing the joint. The inferior, superolateral and inferolateral angles of the scapula were larger in individuals without the joint, although this was not statistically significant. The calculated first rib angles were approximately equal in individuals with or without the joint.

Table 2. *Measurements of the scapulae, clavicles and first ribs in individuals possessing a coracoclavicular joint*†

		Max.	Min.	Mean	S.D.
Clavicle length	(R)	17.50	12.30	14.62	1.16
	(L)	18.55	12.00	14.88	1.35
1st rib height	(R)	5.10	3.35	4.11	0.37
	(L)	4.95	3.66	4.03	0.33
1st rib length	(R)	8.75	6.92	7.89*	0.47
	(L)	8.70	7.16	7.76*	0.47
Scapula border lengths					
Medial	(R)	15.85	12.60	14.25*	1.06
	(L)	15.75	12.60	14.18*	1.03
Lateral	(R)	14.50	10.95	12.87*	0.81
	(L)	14.42	11.10	12.84*	0.75
Superior	(R)	8.40	5.85	7.50*	0.56
	(L)	8.61	6.10	7.65*	0.54
Glenoid length	(R)	4.13	3.15	3.57	0.29
	(L)	4.02	3.10	3.48	0.28
Paracostal	(R)	17.15	13.10	15.21*	1.03
	(L)	16.90	13.25	15.12*	0.94
Scapula angles					
Inferior	(R)	44.83	36.78	40.09	2.03
	(L)	44.80	37.28	40.68	2.08
Superior	(R)	94.69	74.14	82.60*	5.50
	(L)	91.41	76.25	81.95*	5.36
Lateral sup.	(R)	148.84	101.86	111.94	9.10
	(L)	140.24	102.22	111.92	8.16
Lateral inf.	(R)	135.99	92.74	125.03	8.10
	(L)	134.20	98.71	125.45	6.85
Rib angle	(R)	70.72	53.51	58.46	4.71
	(L)	66.42	51.82	58.29	4.48

† Lengths in cm; angles in degrees. * $P < 0.01$.

Table 3. *Measurements of the scapulae, clavicles and first ribs in individuals without a coracoclavicular joint*†

		Max.	Min.	Mean	S.D.
Clavicle length	(R)	16.70	11.65	14.18	0.96
	(L)	16.70	12.15	14.48	0.88
1st rib height	(R)	4.97	3.29	3.72	0.44
	(L)	5.02	3.32	3.82	0.46
1st rib length	(R)	9.10	6.58	7.07*	0.52
	(L)	9.30	6.35	7.01*	0.68
Scapula border lengths					
Medial	(R)	15.62	12.47	13.14*	0.63
	(L)	15.45	12.51	13.00*	0.57
Lateral	(R)	14.20	10.18	11.14*	1.03
	(L)	13.78	10.61	11.29*	0.83
Superior	(R)	8.30	6.20	6.76*	0.46
	(L)	8.40	6.12	6.65*	0.50
Glenoid length	(R)	4.15	3.08	3.48	0.23
	(L)	3.90	3.02	3.37	0.19
Paracostal	(R)	16.70	12.71	13.43*	0.99
	(L)	16.40	12.30	13.25*	0.93
Scapula angles					
Inferior	(R)	45.85	35.50	40.89	2.29
	(L)	43.94	36.92	41.83	1.32
Superior	(R)	89.13	72.42	77.57*	3.54
	(L)	86.84	72.83	77.33*	3.38
Lateral sup.	(R)	157.16	89.77	114.97	15.38
	(L)	150.03	97.57	121.44	11.14
Lateral inf.	(R)	150.75	84.43	126.56	16.09
	(L)	141.25	90.15	119.39	10.73
Rib angle	(R)	75.81	50.21	58.95	5.13
	(L)	65.46	56.46	60.92	2.34

† Lengths in cm; angles in degrees. * $P < 0.01$.

DISCUSSION

Poirier (1890) observed the presence of a coracoclavicular joint in 3 of 10 cadavers studied. Nutter (1941) found the joint to be present in 12 of 1000 radiographs examined, a frequency of 1.2%. Wertheimer (1948) found 2 cases of the joint out of a total of 277 radiographs examined, an incidence of 0.72%. According to Hall (1950), only 54 cases of the coracoclavicular joint had then been reported in world literature, most of these having been discovered accidentally by dissection or during routine radiological examination. Gruber (cited by Wertheimer, 1948) reported 1 case with a true articular capsule among 38 individuals studied.

Lewis (1959) found the incidence of the joint to be substantially greater (11:1) in males than in females. However, both the present study and that of Kaur & Jit (1991) detected no statistically significant differences between the sexes.

Racial variations in the incidence of this joint have been described from osteological material. The incidence of the joint was found to be 9.9% in the Japanese (Ray, 1959) and 0.7% in the Australian aboriginal (Ray, 1959). The percentage incidence in the South African population (9.6%) is comparable with the 9.7% incidence reported by Kaur & Jit (1991) in the Northwest Indian population and the aforementioned Japanese population (Ray, 1959). The joint is said to be more common in Asians than in Europeans or Africans (Abe, 1964; Cockshott, 1979). This is contrary to the results observed in the present study in which both the white (10%) and black (9.4%) South African populations showed similar frequencies to those found in the Japanese and North-West Indian populations.

According to Frasseto (cited by Kaur & Jit, 1991), the joint may develop as the result of abnormal fixation of the clavicle prompted by fracture of the surgical neck of the humerus. Kaur & Jit (1991) found that the presence of the joint was not related to the occupation of the individuals. They further stated that the joint was not a result of any congenital malformation because neither the 35 fetuses nor the 50 neonates studied showed the presence of the joint. They further reasoned that the formation of the joint later in life is conditioned more by genetic than by environmental factors.

Movement of the scapulae in individuals possessing

the joint is thought to be restricted. This could be due to the longer and narrower scapulae coupled with similar thoracic inlet sizes observed in those individuals without the joint. It is proposed that the coracoclavicular joint may develop in individuals having these features so as to facilitate movement, given these space restrictions.

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